

# Patterns of precipitation: Fine-scale rain dynamics in the South of England

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## The effects of climate change on rain

The consensus in the climate change community is that one of the (many) effects of climate change will be that the nature of rain events will change, and in all likelihood, they will become more extreme.

Currently, most long-term rain rate data sets are hourly (or longer) rain accumulations, so investigating the rain events that occur for less than 0.01% (52.5 minutes) of a year is not possible. Rain datasets do exist with smaller temporal resolution, but these are either not continuous, or simply have not been in operation long enough to investigate any trends in climate change.

## Chilbolton Observatory

The Chilbolton Observatory in the south of England is one of the world's most advanced meteorological radar experimental facilities, and is home to the world's largest fully steerable meteorological radar, the Chilbolton Advanced Meteorological Radar (CAMRa). It also hosts a wide range of meteorological and atmospheric sensing instruments, including cameras, lidars, radiometers and a wide selection of different types of rain gauges.



Chilbolton Advanced Meteorological Radar (CAMRa)

The UK atmospheric science, hydrology and Earth Observation communities use the instruments located at Chilbolton to conduct research in weather, flooding and climate. This often involves observations of meteorological phenomena operating below the current resolution of (forecasting and climate) models and work on their effective parameterisation.

## The rain dataset

The drop counting raingauge used in this analysis operates routinely at Chilbolton, England (51.1445 degN, 1.4370 degW). Tipping-bucket raingauges are more common type of gauges, but they have poor resolution of rain rate. Rapid response drop-counting raingauges have been developed at the Chilbolton Observatory to give measurements of every drop (at a high time resolution of 10 seconds) rather than every tip of a bucket. Each drop measured by the drop counting rain gauge corresponds to a rain accumulation of 0.004 mm, and hence 1 drop recorded in a single 10 second integration period corresponds to a rain rate of 1.44 mm/hr.



The rain gauges and disdrometer site at Chilbolton. The area is fenced off to prevent rabbits eating the cables.

Other rain gauge data from Chilbolton includes data from a standard drop-counting gauge, a low-rate drop-counting rain gauge and a standard tipping-bucket gauge, all of which are placed on the ground. Also located alongside the rain gagues is a Distromet Joss Waldvogel Impact Disdrometer RD-69, which measures the drop size distribution of rain.

The dataset used here contains a continuous drop counting rain gauge time series at 10 seconds integration time, spanning from January 2001 to the present.

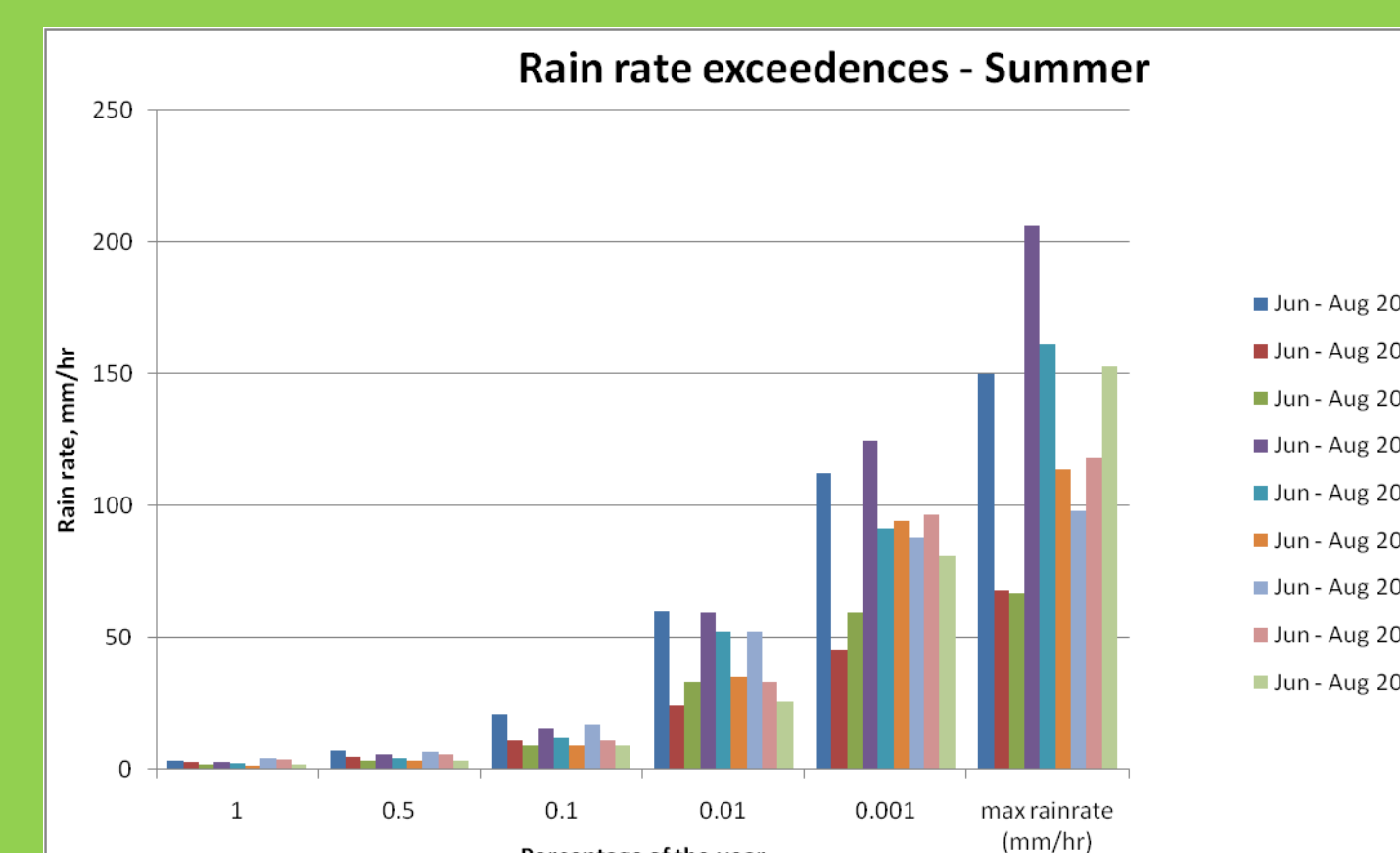
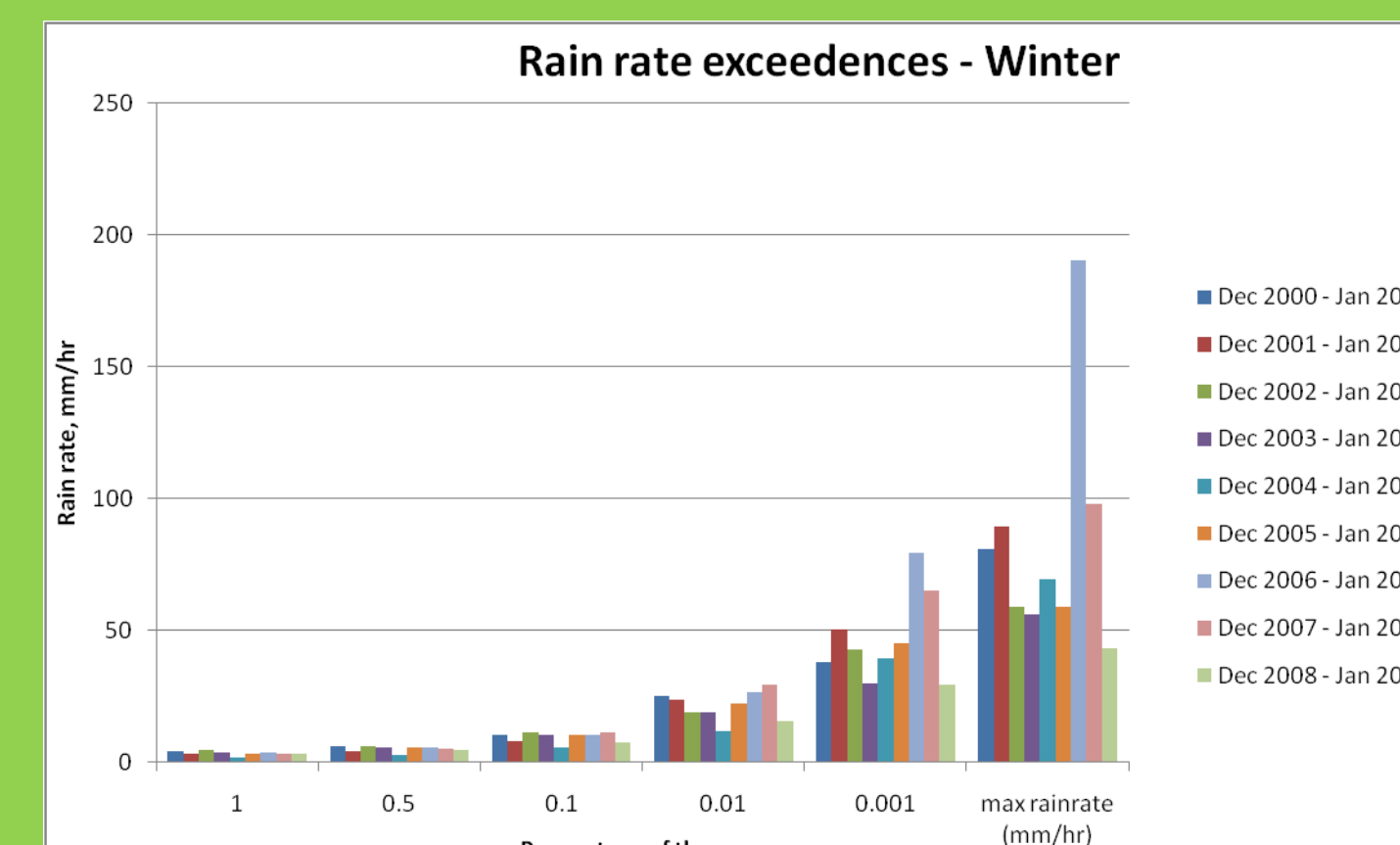
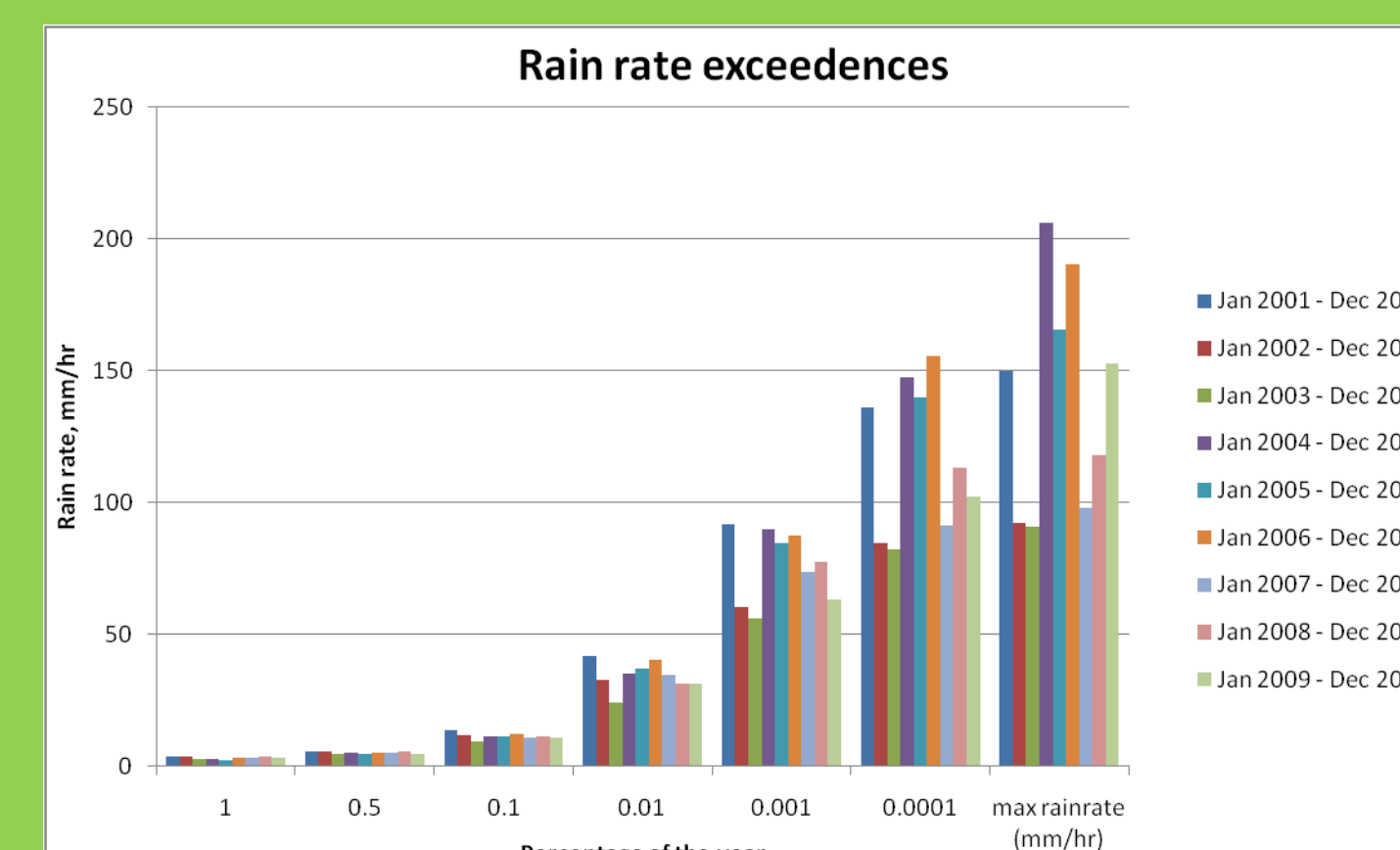
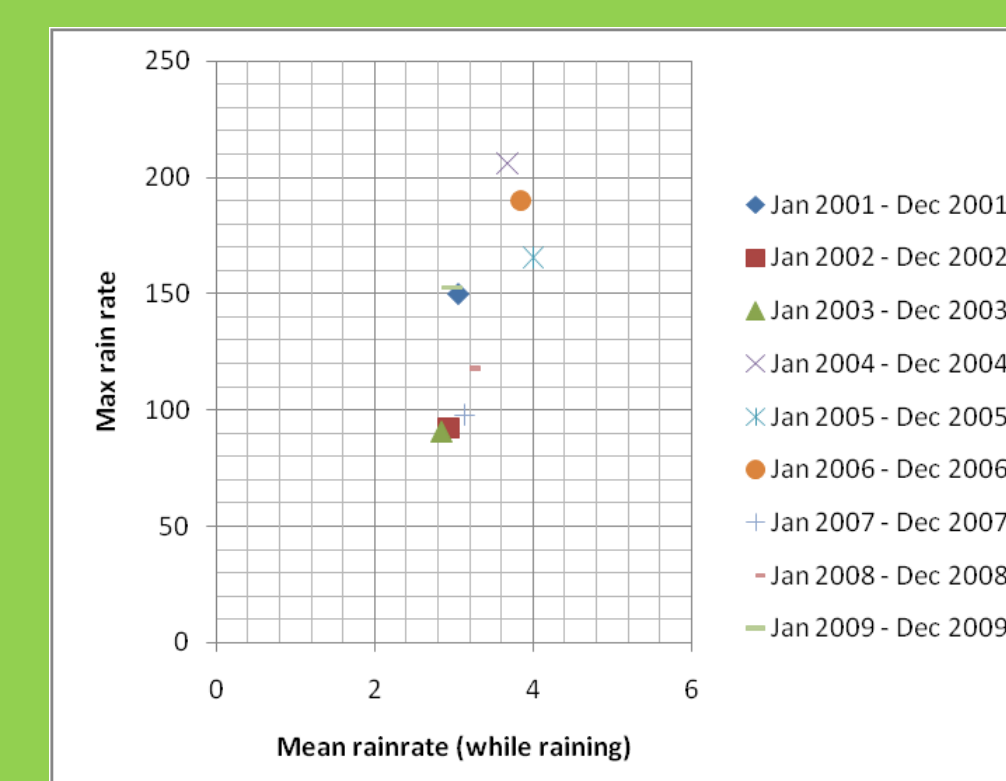


Close-up of the drop counting rain gauge

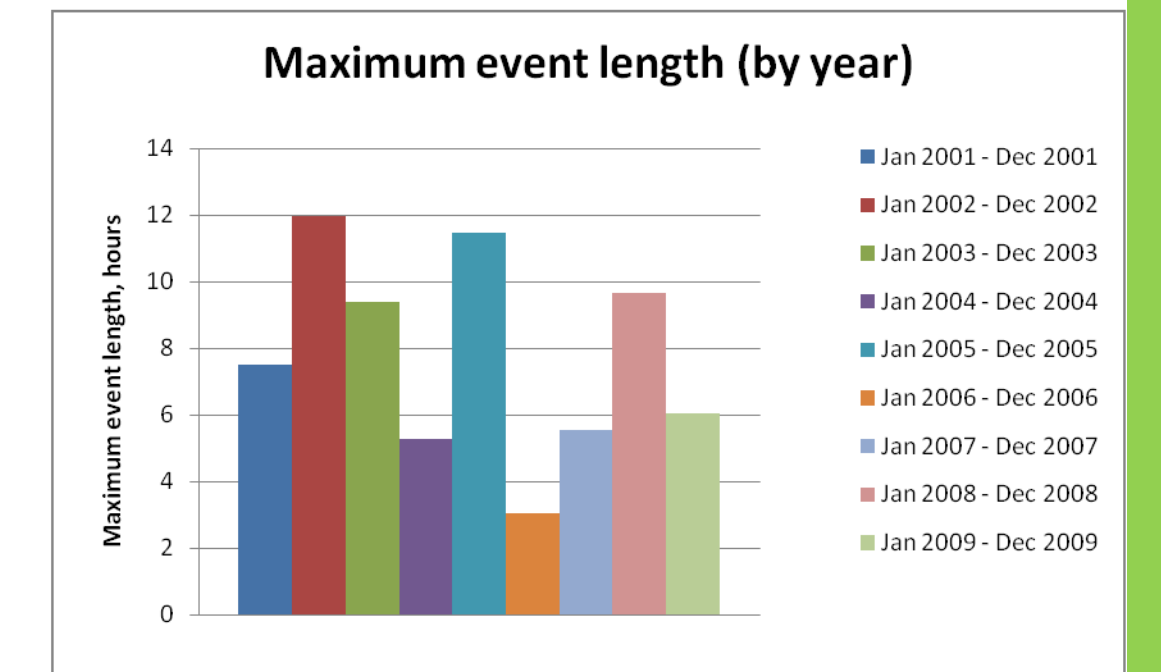
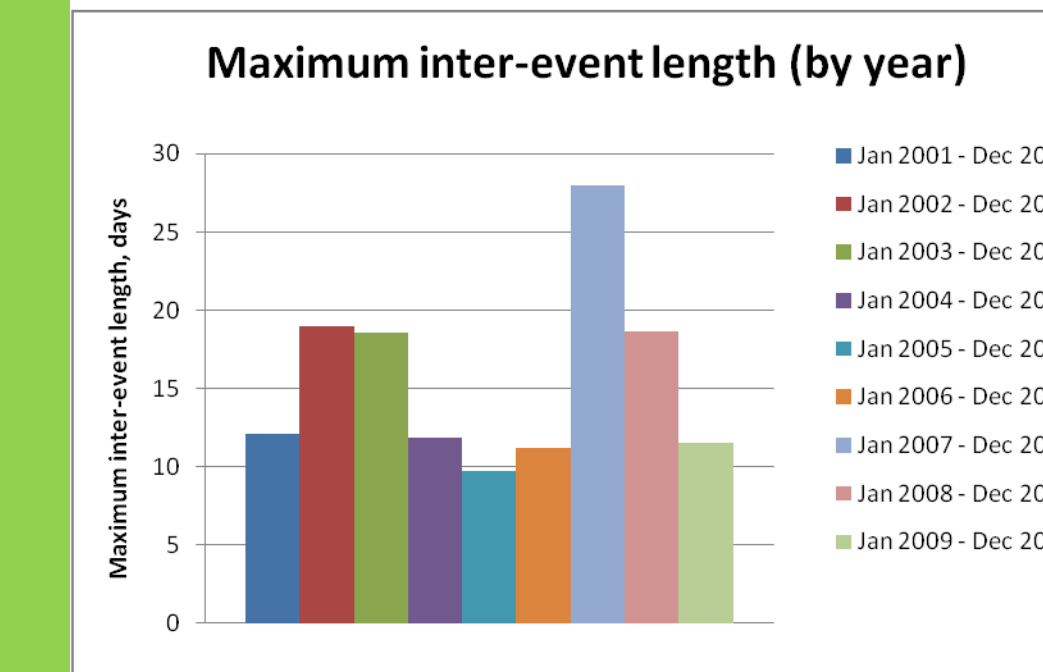
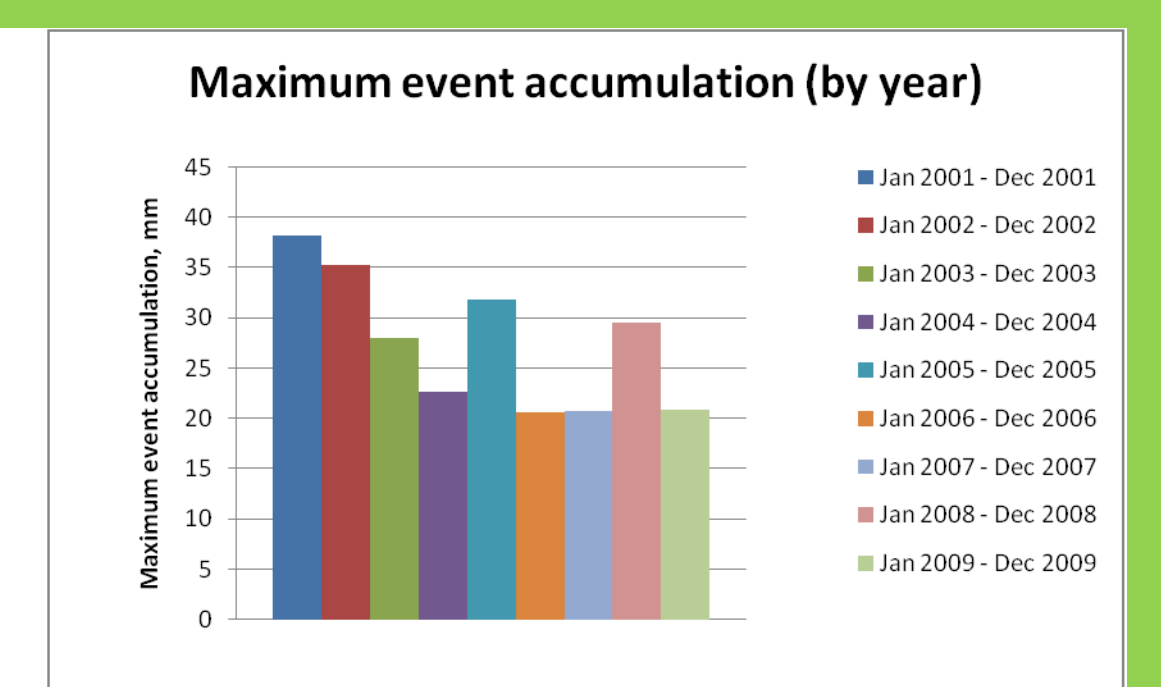
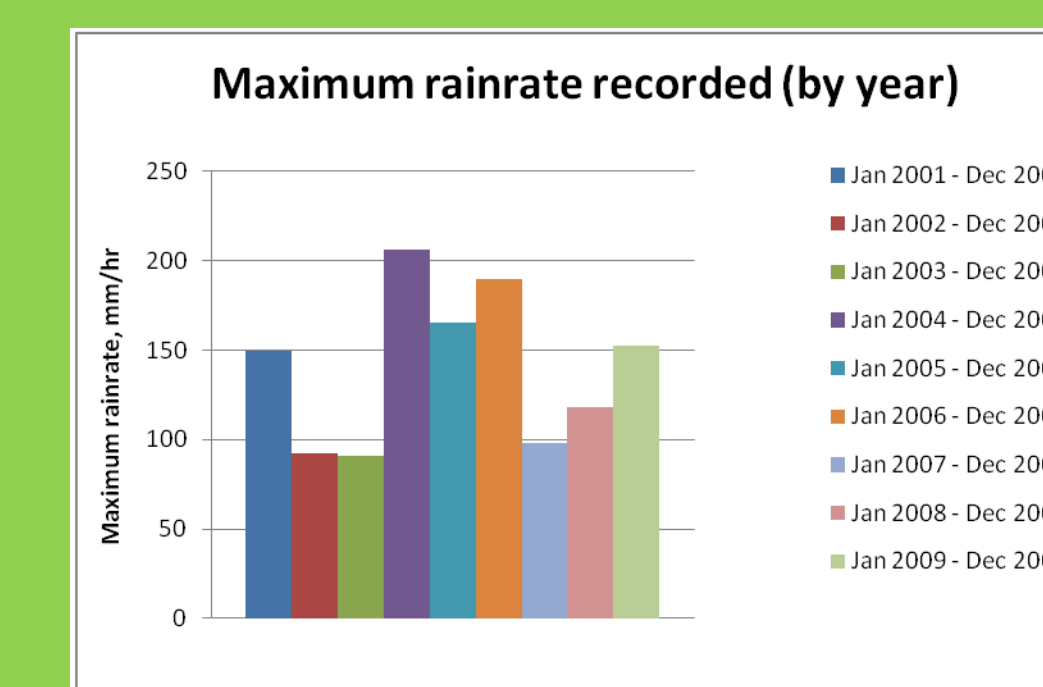
## Statistics from 9 years of drop counting rain gauge data

As can be seen from the figures on the right, looking at the annual and seasonal statistics of rain rate exceedence shows the significant inter-year variability that is expected in rain statistics. However, over the 9 years analysed it is not possible to determine if there is any climate-change related effects.

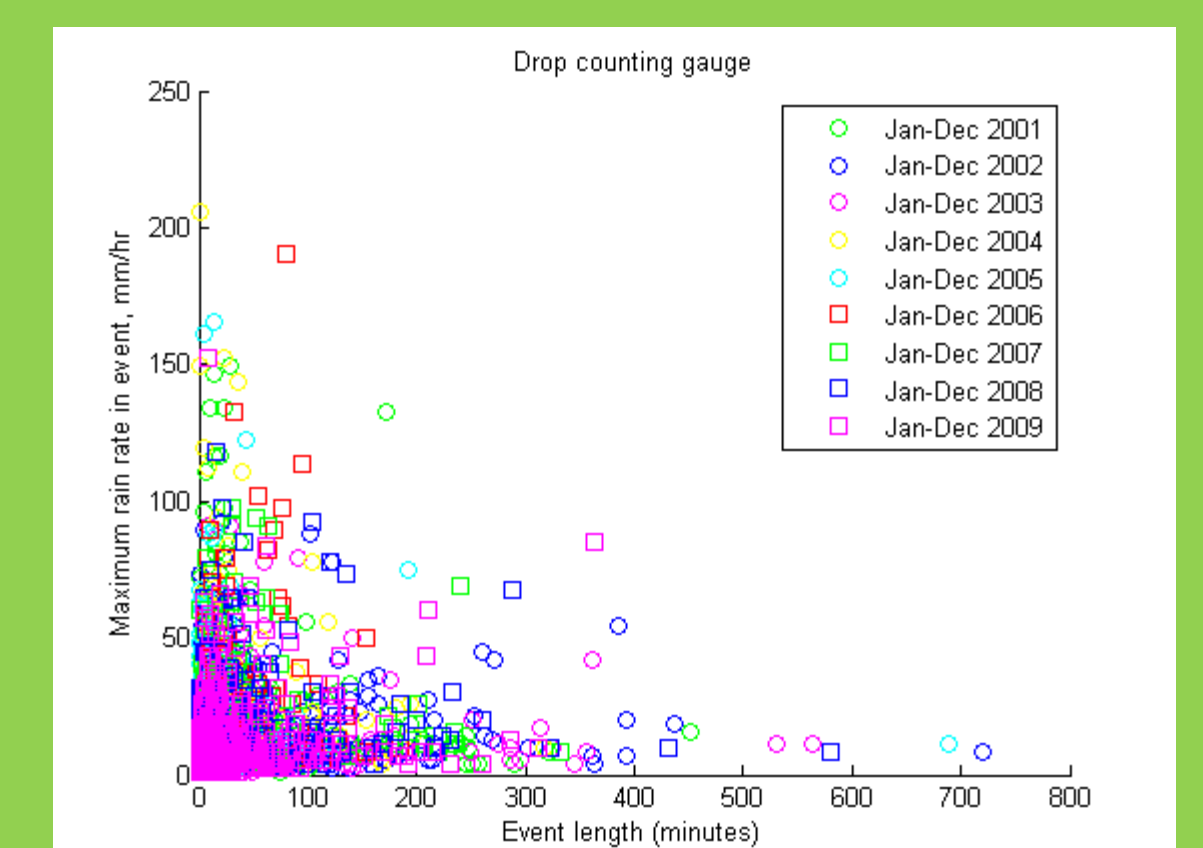
This is not an indication that climate change is not happening, but merely shows that for a single instrument at a single location a significant amount of data is required to build up an accurate representation of climactic variability.



Statistics of the maximum rainrate recorded, the maximum event accumulation, maximum event and inter-event length have also been investigated on a yearly basis. The only obvious trend that can be seen is in the maximum event accumulation, which seems to exhibit a slight downward trend over the 9 years.



Comparing the duration of a rain event with the maximum rain rate recorded in that rain event can give an indication of what types of event are experienced. Short events with high rain rates can be considered to be convective events, while longer events with low rain rates are stratiform. As can be seen below, the majority of rain events are unfortunately not easily categorised by this measure, and so different measurements need to be made to confirm the event type.



Comparison of maximum rain rate recorded in an event against the event length

## Definition of a rain event

For the purposes of this analysis, a rain event was defined as a continuous sequence of rain rates greater than 1 mm/hr. A rain event is considered to be continuous if any gaps in the sequence are less than 30 seconds long. If the rain rate drops below 1 mm/hr for more than 30 seconds, a new event is considered to have started.

## Concluding remarks

Knowledge of the fine scale variability of rain (both in the spatial and temporal domains) is important for the development of accurate models for small-scale forecasting, as well as models for the implementation and operation of rain affected systems, such as microwave radio communications and flood mitigation. As the rain gauge measurements made at Chilbolton will continue for the foreseeable future, these datasets will become increasingly valuable, as they provide a "ground-truth" that can be compared with the results of climate and other models.

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